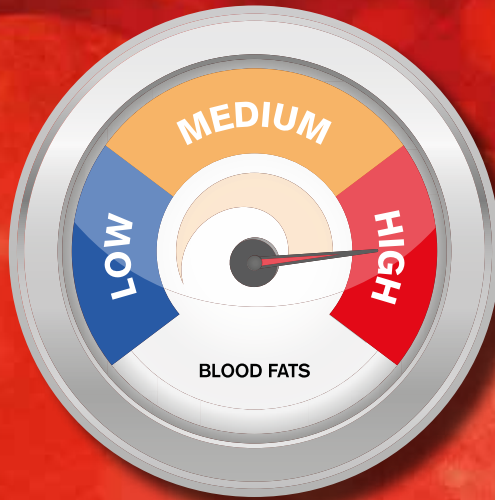




HEART UK
THE CHOLESTEROL CHARITY



Blood Fats Explained

HEART UK – The Cholesterol Charity
providing expert support, guidance and education

Fats in the blood

Fats that circulate in the blood are called **lipids**. **Cholesterol** and **triglycerides** are both lipids. They have essential roles in the body. In excess they are harmful.

Cholesterol is an essential building block for every cell wall. It is also used to make certain hormones and vitamin D. Some of our cholesterol comes from the food we eat; but most is made in the liver. When broken down cholesterol is used to make **bile acids** which help us to digest our food.

Triglycerides are fats which are found in our food. They are also made by the liver. Triglycerides from our food are absorbed in the intestines and transported around the body. Triglycerides provide the energy that is needed by our muscles and organs and for digestion. They also help to keep the body warm.

What are lipoproteins?

Cholesterol and triglycerides cannot circulate loosely in the blood, so they are transported in “parcels” called **lipoproteins**. These lipoproteins are mixtures of fat and proteins (sometimes called **apolipoproteins**) which are combined in such a way as to enable them to mix with the blood.

There are 4 main lipoproteins. They vary in size, content and density.

Chylomicrons are the largest. They carry triglycerides from the intestine to the tissues where they are needed as a source of energy. The number of **chylomicrons** in the blood increases after a meal and then slowly decreases.

Words in **red** are featured in our glossary on page 14.

Very low density lipoproteins (VLDL) transport mainly triglycerides from the liver to where they are used for storage and energy.

Low density lipoproteins (LDL) carry about three quarters of the cholesterol in our body from the liver to the cells that need it. The cholesterol that is carried on LDLs is called **LDL-cholesterol** or **bad cholesterol**.

High density lipoprotein (HDL) plays a vital role in transporting excess cholesterol from cells and artery walls back to the liver for disposal and recycling, a process known as reverse cholesterol transport. Having healthy HDL levels means less cholesterol will accumulate in the artery wall. The cholesterol that is carried on HDLs is called **HDL-cholesterol** or **good cholesterol**.

We also refer to **intermediate density lipoprotein (IDL)** in this booklet. These are cholesterol and triglyceride rich particles.

Unlike chylomicrons the levels of **VLDL**, **LDL**, **HDL**, **IDL** and cholesterol usually change very little after a meal. The levels of these lipoproteins usually reflect longer term diet and lifestyle habits.

Apolipoprotein B is the key protein for chylomicrons, VLDL and LDL.

Apolipoprotein A is the key protein for HDL.

Lipoprotein (a) or Lp(a) is a large “sticky” lipoprotein particle made in the liver. The amount of **Lp(a)** in our blood is largely decided by our genetic makeup. Doctors are interested in Lp(a) because high levels increase the risk of heart and circulatory disease.

At risk of cardiovascular disease?

Cardiovascular disease (CVD) is the medical name for circulatory diseases such as **coronary heart disease (CHD)**, stroke, mini stroke (transient ischaemic attack or TIA), **angina** and **peripheral vascular disease (PVD)**. You are more likely to develop **CVD** the more risk factors you have.

There are two types of risk factors:

Fixed risk factors – these include age, family history and gender. You cannot do anything to change these risk factors.

Modifiable risk factors – there are 4 main ones:

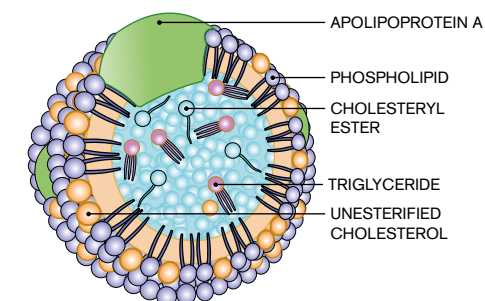
- Unhealthy cholesterol (and triglyceride) levels in the blood
- Smoking
- High blood pressure
- Type 2 diabetes

Stopping smoking can make a big difference to both your short and long term health. People who smoke are more likely to suffer from a stroke, heart attack or breathing problems when compared to someone with the same risk factors who does not smoke. On average smokers die 15 years earlier than non-smokers. Toxins in cigarette smoke put a greater strain on the heart by making it beat faster, they also increase your risk of blood clots and damage the linings of arteries. Smoking also lowers your protective HDL-cholesterol. You can cut your risk of CHD in half, in just one year, by stopping smoking.

Blood pressure is a measure of the resistance to the flow of blood around your body. It is measured in millimetres of mercury (mmHg). Your doctor or nurse will measure both your systolic (upper figure) and diastolic (lower figure) blood pressure. About a third of adults have **high blood pressure**. If untreated it increases the risk of heart attack and stroke. High blood pressure is usually diagnosed when a number of readings are made above 140/90mmHg.

Type 2 diabetes can affect your heart health. This is because it can affect the quantity and quality of fats (cholesterol and triglycerides) in your blood. Usually people with **type 2 diabetes** have increased triglyceride levels (due to an increase in VLDLs), low levels of HDL and smaller sized LDL particles. This pattern increases the risk of developing heart disease.

If you have diabetes your doctor should offer you a statin and advise how you might lower your risk of early heart disease.



The HDL lipoprotein



Lifestyle risk factors

Being overweight, inactive, having a poor diet and stress can increase the risk of CVD. They can also contribute to high blood pressure, cholesterol levels and diabetes.

By making changes to any of the risk factors on this page, you can lower your overall risk of CVD.

How your heart works

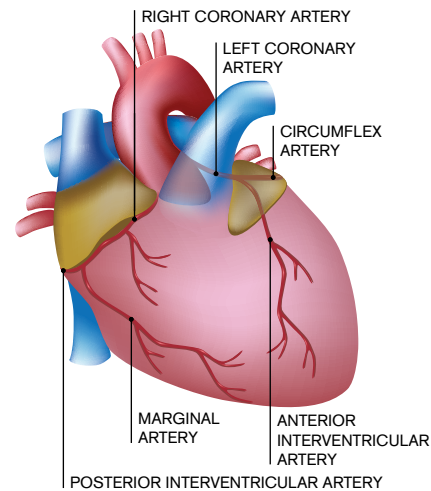
The heart

The heart, blood vessels and blood make up our circulatory system. The heart is a muscle which never stops beating, it acts as a mechanical pump. The left side pumps oxygen and nutrient rich blood to the brain, muscles, organs, and every cell in the body. The right side of the heart is slightly smaller and returns blood to the lungs to be topped up with oxygen.

The heart has its own blood supply which comes from the coronary arteries. These divide many times to provide oxygen and nutrients to every part of the heart muscle to help keep it healthy and pumping normally.

Problems occur when any one of these arteries become narrowed due to the gradual build-up of fatty material (called **plaque** or **atheroma**). This process is called **atherosclerosis**, it happens over many years and causes **coronary heart disease (CHD)**. Sometimes an artery can become so narrow it cannot deliver enough blood. This results in warning symptoms such as chest pain – we call this **stable angina**.

When these fatty deposits become very large or extended they may burst. Just like when you graze your knee, a blood clot and then scarring forms over the damaged area. Over time this damage may partly or completely block the artery. When this happens it is called **acute coronary syndrome (ACS)**, **unstable angina** or **heart attack**. A heart attack is sometimes referred to as a **myocardial infarction** or **MI**.



The heart and the coronary arteries

More about atheromas

Atheromas are areas of inflammation in the blood vessel wall resulting from the build up of fatty deposits.

Risk factors (see page 3) such as smoking, diabetes and high blood pressure can damage the blood vessel lining. This makes it easier for cholesterol (carried on lipoproteins like LDL) to stick on and build up more rapidly. HDL lipoproteins can remove cholesterol from these deposits.

Reducing your LDL cholesterol, increasing your HDL cholesterol and reducing other risk factors can help slow down the process of atherosclerosis.

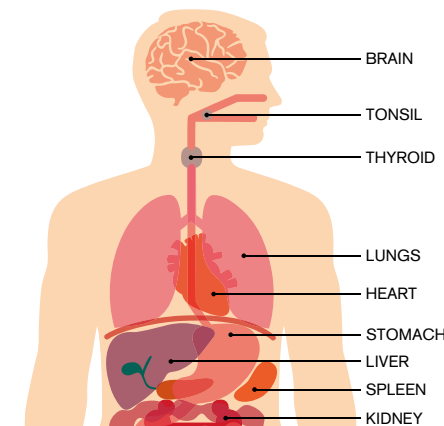
Why your liver is important

The liver plays a central role in controlling the amount of fat in your blood.

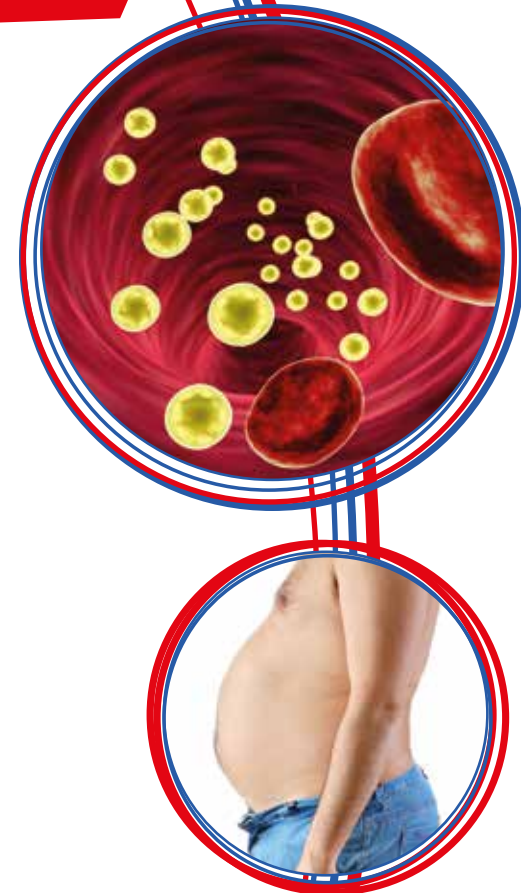
Liver cells have special “hooks” on them that can remove LDL cholesterol from the blood. These are called LDL receptors.

Most of our cholesterol is made in the liver, packaged up and sent to the cells that need it. The liver is also the major site for changing excess sugars, proteins and alcohol into fatty acids and triglycerides, which are then either used for energy or stored for later.

Any fat that builds up in the liver, can damage it. **Fatty liver** can be caused by drinking too much alcohol or by eating too much. It is common in people who carry too much fat around their waistline. It is often symptomless; but too much fat in the liver can affect how well it works and the levels of cholesterol and triglycerides in your blood.



Major organs in the body



Heart facts

- Your coronary arteries supply your heart muscle with oxygen and nutrients
- A heart attack happens when one of these arteries become blocked

- Your liver controls the amount and type of fat in your blood
- Fatty liver happens when your body stores fat inside your liver

Lipid clinics

Lipid clinics provide specialist help and advice to those who have raised blood lipids such as cholesterol and triglycerides and who may have, or be at high risk of developing, CVD.

You may be referred to a lipid clinic if:

- Your GP suspects that you have an inherited condition associated with high blood fats
- You have too much cholesterol or triglyceride in your blood
- You are experiencing problems when taking a statin or other cholesterol lowering medication
- If you need a specialist test

Doctors working in lipid clinics have a variety of names including **lipidologist**, **chemical pathologist** or **clinical biochemist**, or they may be a **cardiologist**, **diabetologist** or **endocrinologist**. Their job is to help identify people with blood fat conditions and to decide on the right treatments.

Lipid specialists may work with **dietitians** and **lipid nurses**, and alongside your **GP**, to help give you the support you need to manage your condition.



Checking your blood fat levels

Your doctor can check the amount of cholesterol and triglycerides in your blood. They are measured in millimoles per litre (mmol/L). Sometimes, but not always, you will be asked to fast overnight before a test. Lipid clinics can also carry out other more specialised tests to help diagnose and manage your condition.

What your levels should be

The average cholesterol in middle aged men and women in the UK is between 5.0 and 6.0mmol/L. If your levels are much higher than this, or if you have existing heart disease, or are at higher risk of developing heart disease, your doctor will want to reduce the amount of fat in your blood as much as possible.

Most lipid experts agree that a total cholesterol of 4 mmol/L or less, a non HDL-cholesterol of 3 mmol/L or less and an LDL-cholesterol of 2 mmol/L or less are good treatment targets to aim for. A fasting triglyceride should be 1.7 mmol/L or less.

It is best to discuss this with your doctor when he or she reviews your treatment. Any target cholesterol and triglyceride levels your doctor suggests will depend on your diagnosis, your age and any other risk factors you have. Talk to your doctor about the levels you should aim for.

Unhealthy patterns of cholesterol and triglycerides in the blood are often referred to as **dyslipidaemia**.

How blood fats cause heart disease

Having enough cholesterol and triglycerides is vital for health. But sometimes we have too much cholesterol, triglycerides, and the lipoproteins that carry them, in our blood. This can result from hereditary factors and/or the way you live your life.

Your doctor will be concerned if, in your blood:

- You have too much LDL-cholesterol or apolipoprotein B
- You have too little HDL-cholesterol
- Your triglyceride levels are high
- You have high levels of Lp(a)*

If in addition:

- You have other risk factors (see page 3)

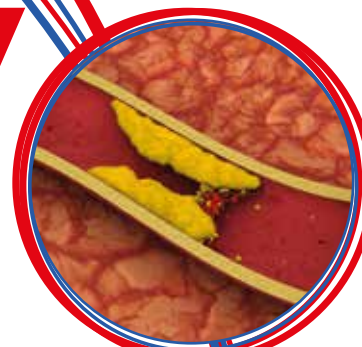
Too much LDL-cholesterol

Too much LDL-cholesterol can be a problem because it can become trapped in the walls of damaged arteries. This can lead to them becoming narrowed. In time the inside of an artery can become too narrow, so very little blood can flow through it. This “furring up” of arteries (called atherosclerosis) happens very slowly, usually over many years. It cannot happen without cholesterol, and the more LDL-cholesterol in the blood the faster the process. Having other risk factors – like being a smoker, having high blood pressure or type 2 diabetes – speeds the process up even more.

***Lp(a)** is a large sticky lipoprotein which is not routinely measured but is linked to an increased risk of heart and circulatory diseases.

High triglycerides and low HDL-cholesterol

Having too many triglycerides in the blood is often coupled with having too little HDL-cholesterol. It may be inherited but can also occur in individuals who are obese, have type 2 diabetes, or who drink alcohol excessively. High triglycerides and low HDL cholesterol can increase the rate of atherosclerosis. Very high triglycerides may cause pancreatitis, a very painful and serious problem of the pancreas gland in the abdomen.



Lipid clinics

Lipid clinics see people who are referred for specialist help and advice by their GP. Lipid clinic doctors and nurses are experts in treating blood fat conditions.

Lipid conditions

Here we describe some of the main inherited blood fat conditions. You can find out more about these conditions on the HEART UK website or by contacting the HEART UK **Cholesterol Helpline**.

Familial Hypercholesterolaemia (FH), usually referred to as FH, results from inheriting an altered gene that causes very high blood cholesterol. "**Familial**" means that it runs in families. "**Hypercholesterolaemia**" means high blood cholesterol. The type of cholesterol that is increased in FH is LDL-cholesterol.

Between 1 and 2 people in every 500 will have FH. It increases the risk of premature CVD if not diagnosed and treated. A pattern of early death from heart disease in close family members is a sign that FH might affect your family.

Total cholesterol levels in adults are normally above 7.5mmol/L and LDL-cholesterol above 5 mmol/L, with normal triglyceride levels. There are few physical signs of FH, but even when these are present they can be difficult to spot.

Almost all people with FH will have **heterozygous FH**, inheriting a single gene alteration from one parent. If you have this form of FH then each of your children have a 1 in 2 chance of inheriting FH.

Homozygous FH is extremely rare and occurs only once or twice in every million births, when a baby inherits a gene alteration from both parents, resulting in extremely high levels of cholesterol.

Familial Combined Hyperlipidaemia (FCH) is an inherited condition that affects about 1 in 100 people. It happens when the body makes too much VLDL and apolipoprotein B. People with FCH usually have higher than normal levels of cholesterol and triglycerides in their blood.

This condition is not as well understood as FH, but is also associated with premature CVD. Raised cholesterol and triglyceride levels may not be present in childhood, and may not appear until people are in their twenties, thirties or even older. FCH is more likely to present early in those people who are overweight or have an unhealthy diet and lifestyle. Checking apolipoprotein B levels can be useful when making a diagnosis.

Polygenic Hyperlipidaemia is the name given to conditions caused by inheriting a mixture of "common LDL-cholesterol" and/or "triglyceride" raising genes. On their own each of these genes would have little effect on blood fats but when combined they can be responsible for significant increases. The term "**polygenic**" means the influence of many genes. **Polygenic hypercholesterolaemia** is relatively common and is influenced by lifestyle, diet and physical activity.

Lipoprotein Lipase Deficiency (LPLD) also known as **familial lipoprotein lipase deficiency** or **chylomicronaemia** is a very rare genetic disorder that affects about one person in a million.

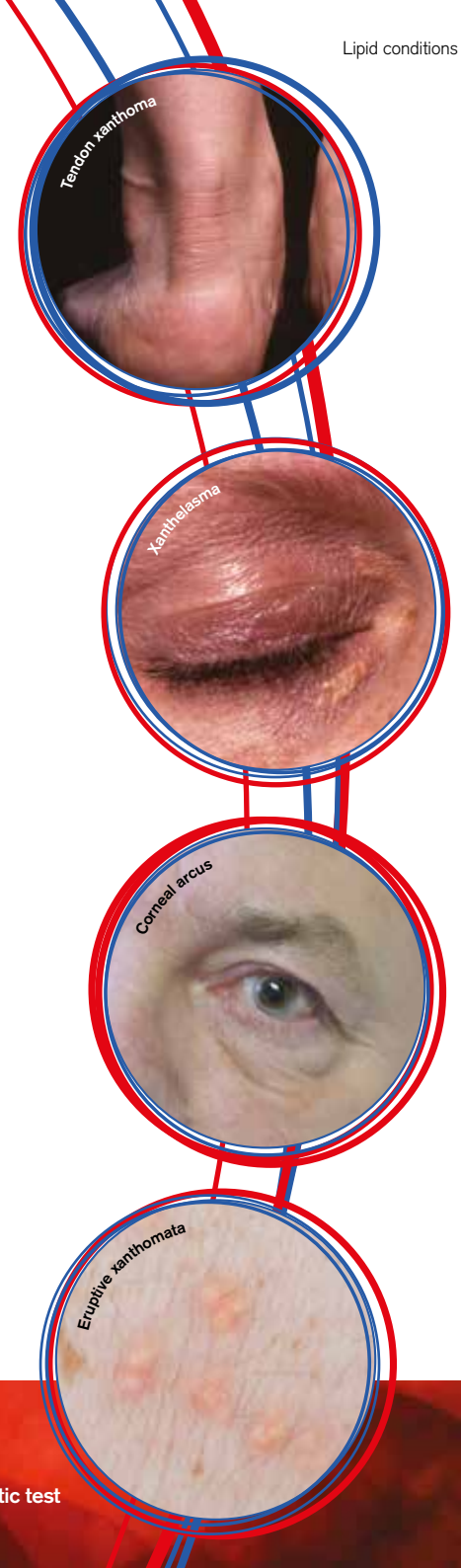
People with **LPLD** have very high triglyceride levels. This is because they lack **lipase**, the enzyme that clears triglycerides from the blood after a meal. Very high triglyceride levels are present from childhood but the condition may not be diagnosed until adulthood. Symptoms include recurrent abdominal pain, fat-filled spots known as 'eruptive xanthomata', and attacks of acute pancreatitis. The main treatment is diet, which must be as low in fat as possible.

Type 3 Hyperlipidaemia is also known as **dysbetalipoproteinaemia** or **remnant particle hyperlipidaemia**.

This condition is thought to occur in 1 in 5000 people, with a 1 in 4 chance of inheriting it from a parent. Both **cholesterol** and **triglyceride** levels are high. Some people with Type 3 have physical characteristics such as yellow deposits (xanthomata) which appear in the creases of the hand (palmar creases) and at the elbows and knees (eruptive xanthomata).

The pattern of **lipoproteins** for Type 3 is very different to other inherited lipid conditions and is key to making a diagnosis. There are increased levels of VLDL and IDL particles, which appear in the blood after meals and which contain both **cholesterol** and **triglyceride**. LDL-cholesterol and apolipoprotein B levels are often low.

Unless treated, people with type 3 are at high risk of **CHD** and **peripheral vascular disease (PVD)**. **PVD** is the name given to changes in the major arteries supplying the legs, arms and major organs. It can result in a poor supply of blood to the legs. One of the main symptoms of PVD is pain in the legs when walking.



Diagnosing lipid conditions

Lipid conditions are usually diagnosed by a combination of:

1. Measuring blood fats and apolipoproteins

2. Looking for telltale signs on the body

3. Taking a family history

4. FH can sometimes be diagnosed/confirmed by a genetic test

Diet and lifestyle

Being physically active

Being active is a great way to lower your risk of heart and circulatory disease, boost your levels of HDL-cholesterol, manage your weight and reduce your waist circumference. It also helps you look and feel great. Adults should aim for at least 150 minutes a week. The exercise you choose should get you slightly out of breath. If you haven't exercised for some time check with your doctor first.

Eating well

A heart-healthy diet is rich in fruit and vegetables, whole grains, pulses, nuts, seeds, fish and vegetable proteins such as soya. Eating well is an important part of your treatment. It can help you to control blood cholesterol and triglyceride levels.

Cut down on saturated fats and replace them with unsaturated fats

Dietary fats fall into two main groups: **saturated** and **unsaturated**. Most **saturated fat** is solid at room temperature and found mainly in foods of animal origin, such as meat, dairy products, butter, ghee and lard. It is also found in hard margarines, coconut and palm oils and in processed foods such as pies, pastries, cakes and puddings. Most foods that are high in saturated fat also contain cholesterol.

We all need a little saturated fat, but too much increases blood cholesterol levels, so an important part of a heart-healthy diet is to limit saturated fat. Instead choose more unsaturated fats (nuts and seeds; vegetable, olive and nut oils; soft vegetable spreads, oily fish, avocado).

Certain foods can actually lower cholesterol if eaten regularly. These include:

- Foods rich in soluble fibre (oats, barley, beans, peas, lentils, vegetables, fruits)
- Nuts (choose unsalted varieties)
- Plant proteins such as soya and quorn
- Dairy foods fortified with plant sterols and stanols*

Certain foods can raise triglycerides and these should be either limited or avoided by people with raised triglycerides:

- Sugar and foods containing refined or added sugars
- Alcohol

See the HEART UK website for more information on how to lower cholesterol and triglycerides. Why not try HEART UK's **Ultimate Cholesterol Lowering Plan (UCLP®)**, our **Low Fat Eating Plan** or call us for a copy of our popular **Diet Guide**.

What about alcohol?

It is best to ask your doctor about drinking alcohol. If they advise it is ok then try to limit alcohol to no more than 14 units spread across the week with several alcohol free days in-between. If you are pregnant you should not drink alcohol at all.

*Foods fortified with plant sterols and stanols are not suitable during pregnancy or when breastfeeding. Children with an inherited blood fat condition may benefit from these foods but check with your doctor or dietitian first.



Five important guidelines for a heart-friendly diet

1. Replace saturated fats with unsaturated fats
2. Eat more whole grains, nuts, pulses, vegetables and fruit every day

3. Choose meat free meals (fish, nuts, pulses, soya, quorn) more often
4. Limit food and drinks high in sugar or alcohol
5. Cook more meals from scratch, and limit takeaway and processed foods

Medical treatments

People at moderate or high risk of CVD are usually offered medicines to lower the level of fat in their blood. This includes most people with FH, diabetes, high blood pressure and anyone who already has angina or has had a stroke or heart attack.

Statins come in tablet form and work by slowing down the production of cholesterol in the liver which is where most of the body's cholesterol is made. Statins are thoroughly tested and very effective at lowering cholesterol, LDL in particular. They are generally well tolerated and have been shown to extend life by preventing CHD. If generalised muscle aches occur, these should be reported to the doctor. Statins should not be used to treat people with significant liver disease, and they are not used in pregnant women or women who might become pregnant.

Fibrates come in tablet form and may be useful when both triglycerides and cholesterol are raised. Fibrates are well tolerated but should not be used during pregnancy or by individuals with significant liver or kidney disease.

Resins (bile acid sequestrants) come as powder, granules or tablets. The powder and granules are taken by mixing with water, fizzy drinks, fruit juice or yoghurt. They work by preventing the re-absorption of **bile acids** in the intestine, which means that more cholesterol is used up in replacing them. Resins are safe for children and pregnant women because they are not absorbed into the body. Resins can cause wind and constipation which can be a problem for some people.

Ezetimibe: Ezetimibe blocks the absorption of cholesterol and bile acids in the intestines. When combined with a statin drug they can greatly enhance the overall cholesterol lowering effect and can help people to reach their cholesterol targets. Ezetimibe may also be prescribed for those unable to tolerate statin therapy.

PCSK9 inhibitors are a new class of drugs. They are given by injection once or twice a month and are very effective at lowering cholesterol. They appear to be well tolerated. Talk to your lipid specialist about whether they may be suitable for you.

Omega 3 fish oils (1-4g daily) reduce plasma triglyceride levels in some lipid conditions. They work by reducing VLDL production in the liver. To get the equivalent of 1g of fish oil per day you would need to eat three good portions of oily fish per week.

Lipoprotein apheresis: Lipoprotein or LDL apheresis is not a drug, it is a treatment similar to kidney dialysis. A person is connected to a machine that removes LDL-cholesterol, Lp(a) and triglycerides from their blood. The 'cleaned' blood is then returned to them. The process takes about 3 hours to perform and has to be repeated at weekly or fortnightly intervals. The procedure is expensive and is only currently available in a few specialist centres. It may be considered when people still have a high cholesterol level despite taking all available or tolerated medications and a healthy diet.



Statins and Ezetimibe can be prescribed by your GP but the other medicines are usually only prescribed by specialists. From time to time new medicines and treatments are developed for people with raised blood fats.

At a glance guide to medical terms

Acute coronary syndrome (ACS): The term for any condition brought on by sudden reduced blood flow to the heart.

Angina: Usually severe pain in the chest, sometimes spreading to the shoulders, arms, and neck, caused by too little blood getting to the heart muscle.

Apolipoprotein - see lipoprotein.

Atheroma (plaque): Fatty deposits inside the artery wall.

Atherosclerosis: The process by which arteries become narrowed over many years.

Bile acids: Used in fat digestion, these are made from cholesterol.

Cholesterol: An essential building block, needed for growth and good health.

CHD – Coronary heart disease: When one or more of the coronary arteries become narrowed or blocked.

Chylomicrons, VLDL, LDL, HDL, IDL: Types of lipoproteins that carry fat around in the blood.

CVD – Cardiovascular disease: A collective term for circulatory diseases such as coronary heart disease (CHD), stroke, mini stroke and peripheral vascular disease (PVD).

Dyslipidaemia: A general term for an altered and unhealthy pattern of blood fats.

Familial: Used to describe conditions that run in families.

Fatty liver: Fat becomes stuck in the liver. It can stop the liver working properly.

Heterozygous: When a gene alteration that causes a characteristic or medical condition is inherited from one parent only.

HDL-cholesterol: Good cholesterol, it takes excess cholesterol back to the liver where it can be disposed of.

Homozygous: When a gene alteration that causes a characteristic or medical condition is inherited from both parents.

Hypercholesterolaemia: High blood cholesterol.

Hyperlipidaemia: High levels of cholesterol and triglycerides in the blood.

Hypertriglyceridaemia: High levels of triglycerides in the blood.

LDL-cholesterol: Most cholesterol in the blood is in this form. It is also referred to as bad cholesterol.

Lipids: The name for fats in the blood.

Lipoproteins (apolipoproteins): The fat and protein parcels that carry fats around the body.

Lp(a): A large "sticky" lipoprotein; high levels increase the risk of heart and circulatory disease.

MI – Myocardial Infarction: A heart attack.

PVD: Peripheral vascular disease – partial or complete blockage in the main arteries that supply the legs, arms and major organs.

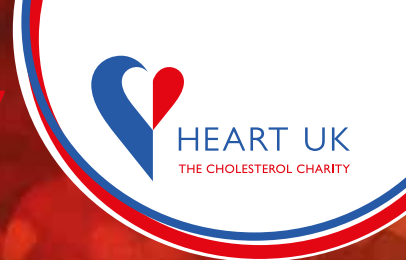
Polygenic: The small effects of many genes.

Saturated fat: The type of fat that can increase your cholesterol, it is found mainly in animal foods.

Triglycerides: Another name for fat, it is found in foods and in the blood. Triglycerides are made from three fatty acids and one glycerol molecule joined together.

Unsaturated fat: The type of fat that does not increase your cholesterol level. Most of the fat we eat should be unsaturated.

HEART UK – The Cholesterol Charity



We are the only UK charity dedicated to providing expert support, guidance and education for people with raised blood fats.

Our Cholesterol Helpline

Being told you have raised cholesterol or triglycerides can be worrying and confusing for you and for your family too. Our Cholesterol Helpline, provides a 'lifeline' for people worried about blood fats.

Our nurses and dietitians can answer all your concerns and worries, advise on diet and lifestyle and help ensure you get the best care and support you need to maximise your long-term well being.

T: 0345 450 5988 (Monday-Friday 10am-3pm)

E: ask@heartuk.org.uk

Urdu, Punjabi & Hindi speaker most Fridays

Our website

We have lots of easy to read advice on coping with blood fats, when to take a statin and how to make changes to your diet and lifestyle.

Don't forget to sign up for Cholesterol e-news when you visit our website.

W: www.heartuk.org.uk

Follow us



It's easy to donate

Thousands of people with high cholesterol and triglycerides turn to us for advice every year. We rely on your support to fund our vital work. Could you help us with a donation? Any amount, however small, can help fund our essential work and save more lives.

Visit – www.heartuk.org.uk/donate

Ring – 01628 777046

Text – HART20 and the amount – £5 or £10 to 70070.

Send – a cheque made payable to HEART UK to:

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SL6 1PE

Thank you.

HEART UK – The Cholesterol Charity
providing expert support, guidance and education

*Reducing consumption of saturated fat contributes to the maintenance of normal blood cholesterol levels. Shredded Wheat is low in saturated fat.